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# Mobile technology to support coherent story telling across freely explored outdoor artworks

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## ABSTRACT

Museum professionals create exhibitions that tell stories about museum objects. The exhibits are usually arranged to reveal the relationships between them and to highlight the story being told. But sometimes objects are in fixed places and cannot be re-positioned. This paper presents a solution to the problem of how to tell conceptually coherent stories across a set of fixed artworks within the grounds of a museum and to reveal relationships between them. A study was conducted in which QR codes were used to provide access, through mobile devices, to online information about artworks. A notion of conceptual coherence and coverage of artworks was used to construct online story trails linking artworks to each other based on overlap of key story features such as setting, people and themes. Visitors were free at all times to follow their own path through the museum grounds and choose which objects they wanted to stop and engage with. The QR code trail was evaluated on an outdoor art trail at the Irish Museum of Modern Art (IMMA). Analytics of page access were used to identify how often visitors scanned QR codes and to what extent, once they had visited the online information about an artwork, they were likely to follow the story links.

## Author Keywords

digital storytelling; mobile devices; QR codes; museums

## ACM Classification Keywords

H.5.4. Hypertext/Hypermedia: User issues

## INTRODUCTION

Visitors to museums are not only interested in discovering all about individual objects, but also to understand the wider context of an exhibit, in terms of historical background and how it is related to other items on display.

When a museum professional constructs an exhibition they commonly aim, as much as possible, to organise items so that these stories and thematic relationships can be easily highlighted to visitors [1].

But still there may be alternative stories to be told across the set of items that are not reflected in the primary physical organisation. Similarly, outdoor artworks are a popular addition to the grounds of many museums, and indeed many other public spaces such as towns, parks, public gardens. Often they are not selected as part of a single exhibition, but are acquired over a period of time and placed with reference to the physical rather than a conceptual context. Despite this, relationships often do exist between outdoor artworks, based on artists, materials, art period, theme of a piece, historical events. These stories can be hard to reveal, because the artworks cannot be moved and because information provided for artworks in outdoor spaces is often quite minimal.

Mobile technology offers the possibility to address this need. Mobile applications can make information about an artwork available on a user's own device and also show the conceptual links that are not reflected in a physical layout. They can be used to provide additional information, in text, audio, image or video format, to contextualise museum objects and encourage situated learning [2]. This paper explores what it means to be following a physical pathway between cultural objects whilst trying to also perceive an alternative conceptual configuration. We introduce the notion of the physical neighbourhood in which pieces are situated, the shape and layout of which influences the coherent physical pathways chosen by visitors, through physical proximity and line of sight [3]. On the other hand, there is the conceptual neighbourhood of each artwork, describing for example people, times and places associated with it. This also has an influence on how a visitor might coherently navigate from one item to the next, using an equivalent notion of conceptual proximity. The paper then explains how these ideas were tested using microsite stories that can be accessed on mobile devices using QR codes. The microsite stories were constructed using Storyscope, a web-based environment to support museum storytelling about and across objects and which contains a number of recommender components to support museum authors, one

of which was applied to find coherent conceptual trails of artworks to reveal through the microsite. The paper concludes by looking at data from evaluation of the QR code trail and envisaging where the technology could be used next.

## RELATED WORK

Much of the work in museum technology is targeted at supporting cultural visits within museums. Some systems have focused on creating personalised tours, conceptually linking a number of exhibits [4, 5]. Others provide novel ways for browsing, viewing and navigating across museum content. For example, CultureSampo [6] provides a set of themes through which content can be explored using timelines or maps. The Agora project [7] develops technology to facilitate the navigation of museum objects using associated metadata of events that are associated with the object, describing activities, locations, people.

In earlier days of museum technology, systems would be presented through fixed terminals within museums or available on museum websites that visitors could access pre or post visit. These days, the focus is on providing mobile applications to help engage visitors with the content. In Museum Scrabble [8] children use an RFID scanner to scan artworks which they must then link to text they have been given. There is both a collaborative and a competitive element, with children working in competing teams. MuseUs [9] encouraged visitors to curate their own exhibition by selecting items from an existing exhibition. Visitors were guided in by trying to match items to text they were given, their choices were then used to create an 'art appreciation' profile from which a booklet of items they might be interested in was presented.

More recent work has focused on investigating how mobile devices can help visitors to engage with and learn about culture when 'out and about' in cities and historic sites. City Treasure [10] sends children on a treasure trail around a city, using SMS messaging to mediate interaction and send clues. Goals are tailored to the age of the group doing the hunt, but effectively they lead the children into learning more about the cultural sites in the city. There is a competitive element to engage children, giving points for the types of observations they make. Also aimed at children, O'Munaciedd [11] is a treasure hunt in which children explore a city by trying to find a character called O'Munaciedd and grab his hat. Their route and clues are given on a hand-held device. In answering the clues, children also learn something about the culture of the city. In REXPlorer [12], tourists are wizards, who can cast spells by waving their mobile device in a certain way. By casting a spell, the tourist gets to hear stories related to their current location, as well as being sent on quests. As tourists undertake quests they also take photos. At the end of the game the story of their travels is turned into a blog. Sharing the square [13] encouraged collaboration and sharing between city visitors, so that one visitor's contributions of

photographs, text, web resources or audio could be used as part of recommendations to future visitors. Similarly, city visitors could share their experiences of a physical setting to remote visitors who are not actually there, but who have the means to make requests of those who are physically present. Travel Teller [14] investigated the use of theme to propose how to organize stories from traveller's photographs and also to provide prompts for where they could go next to continue their story. Evaluation found that travellers were often less interested in reaching a recommended destination than in some of the things they might discover on the way, which they felt had an element of surprise. Sometimes the places they found along the way would suggest new goals that conflicted with the original recommendation.

In each of these examples, information is attached to different locations in the physical space and visitors can access this through various means. Commonly this leads to the visitor being directed towards the next point of interaction and so on, leading them on some sort of connected trail across a city. Whilst these experiences are undoubtedly interesting, not every visitor wants to travel on a route and some visitors prefer to choose their own paths.

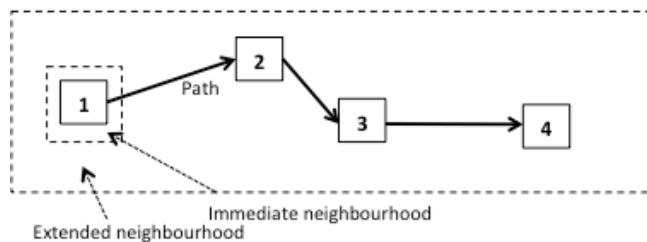
The problem addressed in this paper is how to create an application that provides a similarly coherent experience across a set of objects in a physical space, yet allows visitors to freely explore and choose what to stop and engage with, without suggesting where they need to go next. At the same time, information provided to a visitor – even when about other artworks – is always conceptually close to the object they are standing in front of. The scenario that is evaluated is exploration of artworks in the grounds of a museum.

## PHYSICAL AND CONCEPTUAL NEIGHBOURHOODS AND TRAILS

A neighbourhood defines a region around an artwork. In the immediate physical neighbourhood, a visitor is able to walk around and view an artwork from different perspectives. They can also stand at that artwork and, by looking around, perhaps see others that share the same space within an extended physical neighbourhood. This may prompt them where to go next, or allow them to plan a trail that takes in several artworks one after the other. A trail may also be afforded by the layout of the space. For example in the grounds of the Irish Museum of Modern Art (IMMA) a number of artworks are found along a driveway from one of the entrances. It is common for visitors to visit these in a particular order. Most visitors will prefer to follow a coherent trail between artworks, in which they do not have to double back and re-pass artworks they have seen before. When the museum layout dictates that they must back-track to reach an unexplored area, visitors will generally ignore works they engaged with on a previous pass, unless they were of a particular interest to them.

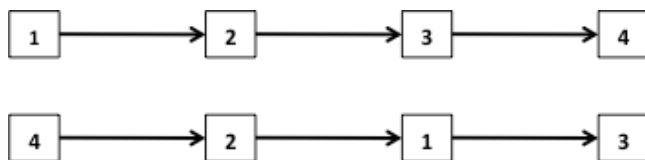
In the immediate conceptual neighbourhood of an artwork, a visitor may come to understand about the person who created it, what the artwork is about, when, where, how and from which materials it was created and maybe where it has been exhibited before. This information is commonly conveyed by a combination of metadata and stories associated with the object. The extended conceptual neighbourhood of the artwork may also contain additional artworks that share some of the same conceptual space, for example they are made by the same artist, of the same material, have the same theme, or are linked through shared events in history. In much the same way that a visitor can follow a coherent physical trail between artworks, they can also follow a coherent conceptual trail that informs how the artworks are related to each other.

Figure 1 shows the immediate and extended neighbourhood of an artwork in either a physical or conceptual space, as well as a possible coherent trail between artworks within that physical or conceptual space. Each path is organized by proximity (either physical or conceptual distance).



**Figure 1. Neighbourhoods and coherent trails in either a physical or conceptual space**

The boundary of either a physical or conceptual neighbourhood is generally decided by 'ownership' or where a gap becomes too large between one item and the next. For example, in the physical space objects outside the grounds of a museum, or a long distance to walk. In the conceptual space, objects that contain no conceptual overlap with any other objects in the same neighbourhood, or which cannot be included due to copyright or other similar issues. For outdoor artworks, which cannot be moved to reflect a conceptual trail, in most cases there will be a mismatch between a coherent physical path that a visitor might take and the conceptual path that tells a coherent story across the artworks (Figure 2).

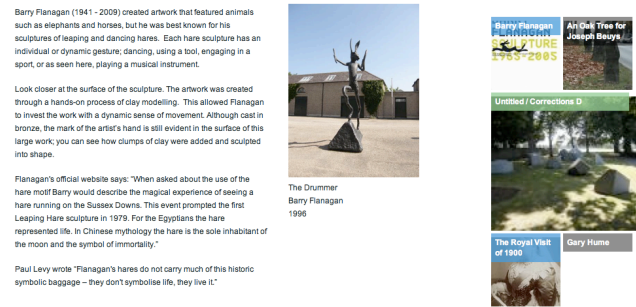


**Figure 2. ordering objects along physical and conceptual paths**

## STORYSCOPE – STORIES, EVENTS, OBJECTS

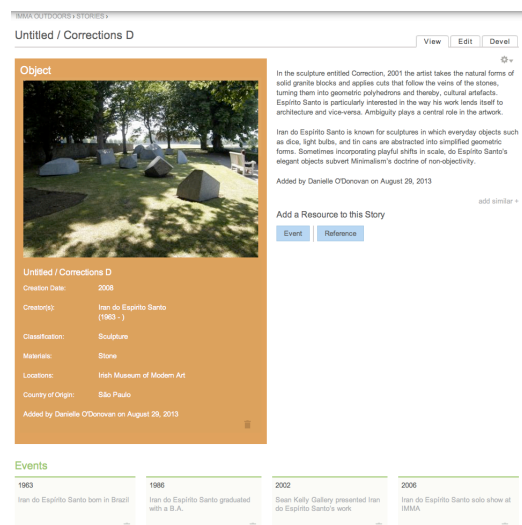
Storyscope is a web environment for authoring stories that reveal relationships between museum objects. Storyscope supports the publishing of stories as navigable microsites

(see figure 3), which are essentially a web equivalent to all, or part of, a physical exhibition, museum catalogue, handout or tour.



**Fig. 3. A microsite produced from Storyscope**

Storyscope is based on the curate ontology that describes the important concepts of museum storytelling. Thus, the narrative consists of a number of distinct *story sections* each reflecting a specific theme from the overall narrative. This is roughly equivalent to the separate rooms of a museum into which objects are thematically grouped. Within an individual story section are the *objects* and *stories* related to this theme. An object story is like the panel of text that appears alongside an object. Across the narrative, the story section is ordered into a *trail* which leads the visitor from one section to the next in a coherent way, for example leading the visitor through time periods or different stages of an artists career. In the microsite, the order of visiting sections is suggested by the ordering of the hyperlinks. A *dossier* is used to collect the content for creating a narrative. For full details of the concepts within the curate ontology and how they are related, see <http://decipher.open.ac.uk/curate/introduction>.



**Fig. 4. Example of an object story in Storyscope**

Using Storyscope, an author can select and write stories about museum objects, whilst recommender components use narrative principles to suggest ways to extend [15] and



structure the content. This is made possible through the representation of stories in terms of their important *events* describing the people, setting (time and location) and themes (historical period, genre, materials, activities) and through the object metadata. Figure 4 shows an example of an object story, with object metadata and some story events.

### The Narrative Recommender

Storyscope has a narrative recommender, which uses the object metadata and story event properties to propose how to organize story sections into coherent trails. This recommender uses notions of *coherence* across sections and also *coverage* of available story events and objects that would be included in the proposed trail.

Coherence is measured by the cosine similarity between a group of property vectors. Property vectors are obtained from both event properties and object metadata of the object stories associated with a story section. Coverage of events or objects is measured with respect to the total number of each available to the story, i.e. all objects and events that have been put into the dossier of the narrative as potential building blocks for the story.

A trail is produced by hill-climbing from a number of randomly selected start points. In each step, the result of merging story sections that are not already in a trail is evaluated in terms of what this merging contributes towards increasing a score, which is weighted according to how important coherence, event and object coverage are for that particular narrative output. The best section is always chosen. When there are no sections that can be chosen that increase the score, the path is returned.

A trail developed in this way has a natural order. Considering a situation where coherence is considered to be most important, then from the starting point the next section chosen must be the most coherent with respect to that starting point. In the next step, the section chosen is the one that is most coherent with respect to the entire path up to that point. Therefore, in each step the overall coherence of the trail is considered and not just the local coherence to the previous step.

The narrative recommender was developed through several iterations, which included evaluation by museum professionals and improvements in response to feedback received. Evaluation revealed a clear preference for highly coherent outputs over inclusion of more objects or events. This means that often the trails produced are quite short, but densely connected.

### IMMA CASE – QR CODE TRIAL

As part of the Storyscope evaluation, IMMA were interested in applying the narrative recommender to the task of discovering conceptually interesting visitor journeys through 27 artworks in the ground of the museum and in using Storyscope to publish a microsite for access via a mobile device. The goals were to further evaluate the output

of the narrative recommender in terms of the usefulness of the conceptual trails discovered amongst only minimally related artworks (compared to more formally constructed exhibition content), to provide a task context for thinking about how to facilitate visitors in navigating both physical and conceptual space (as described in the previous sections) and to discover how willing visitors were to use mobile technology at the same time as engaging with the outdoor artworks. QR codes were selected to mediate interaction for two reasons, firstly they are cheap and easy to set up compared to other options such as GPS tracking (which in any case is not always accurate for objects that are very close to each other) or more recent technologies such as iBeacons (which has an initial outlay) and secondly because they have a visual presence, which was essential since the aim was to track spontaneous engagement with the technology rather than recruit participants. This had impacts for other areas of the evaluation, such as the ability to collect direct feedback from participants. In fact, data was gathered via Google Analytics.

In order to access content, a visitor had to find a QR code that was placed next to the artwork in the museum grounds and scan it using their mobile device (Figure 5). This would take them to a landing page, which contained information about the artwork.

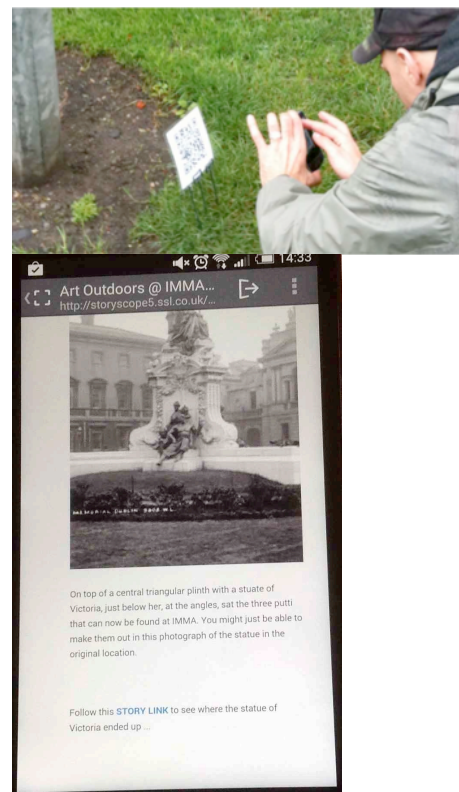


Fig 5. IMMA visitor scanning a QR code and one of the landing pages on a mobile device.

A 'landing page' was a story section authored in Storyscope. It included a picture of the object and stories

associated with the immediate conceptual neighbourhood, such as when the piece was made and who by. To navigate through the extended conceptual neighbourhood, visitors could click on *story links* at the bottom of the main page. This would take the visitor to a page containing either further background information to the current object, or other conceptually related objects in the grounds.

Museum experts used Storyscope to create these landing pages (a story section) for each of the 27 objects in the grounds, plus additional story sections with background information for some of the artworks. The recommender produced 18 trails from 27 starting points – 9 artworks were not found to have conceptually related story sections. The longest trail produced was 6 story sections long. The IMMA experts assessed these and selected 15 to include in the evaluation, 6 with some minor modification. Since the narrative recommender was used to create the trails for the story links, each story link led to a new story section that was conceptually further from the landing page. A trail of story links ended when there were no further sections to include that would maintain the coherence of the trail.

In order to find more content, the visitor had to walk to another QR code and scan that to reach a new landing page and new story links. To aid this, at the bottom of each landing page text there was also a brief sentence referring to the extended physical neighbourhood, inviting the visitor to ‘look around! You should be able to see more artworks and QR codes from here’ or ‘now head up the avenue! You should be able to see more artworks and QR codes along the way.’

Thus, the visitor was able to select their own coherent physical path through the physical neighbourhood, yet still access the immediate and extended conceptual neighbourhood of each artwork. They might later come across an artwork for which they have already accessed the related microsite information in the context of an artwork they visited before. They might then also find an online trail similar to one they had seen before, but presented in a different order. No attempt was made to record which content had been viewed by a visitor and tailor/omit content accordingly. Each access through a landing page was designed to be a complete, conceptually coherent experience in its own right and to support the visitor in that moment, regardless of where they had been or where they might go next.

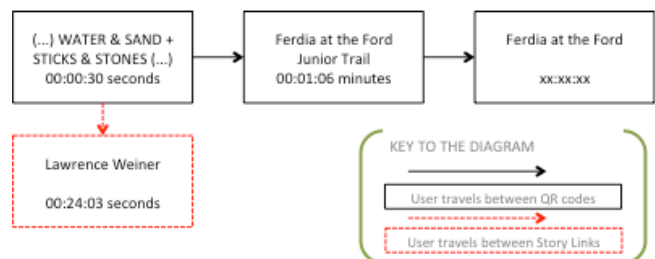
## Evaluation

The microsite was designed to support visitors who were browsing the grounds, possibly prior to visiting a more structured exhibition within the museum building. Access to the grounds is free and visitors therefore can come and go without having to pass a paying booth. The aim was to find out if these visitors might be tempted to engage with artworks by scanning QR codes, without prompting and without having picked up any leaflets or making any

commitment to follow a trail. Visitors could spend as long as they wanted to browsing, and could scan as many or as few QR codes as they liked. Visitors did not have to come into contact with any experimenter and therefore it was not possible to get direct feedback from every visitor, although a link to a survey was provided and some respondents did fill this in.

Evaluation was conducted using Google analytics to record and track how the visitors accessed the landing pages and the embedded story links. It was hypothesized that engaged users would explore the narrative using a mixture of physical proximity and story links, reading one section and then another (by following a link) before moving on to the next physically nearest object of interest. In addition, the evaluators sought to test whether visitors would be more inclined to follow location-based prompts (by scanning visible QR codes) or to follow the story links generated through Storyscope’s narrative recommender.

The QR code trial was conducted over 2 days. In total 47 separate visitors scanned at least one QR code in this period. 29 of these scanned only one code and did not investigate further. Of the rest, 10 users visited between 2-4 pages, and 8 visited between 6 and 12 pages. As IMMA grounds can be accessed freely by the public, there are no total visitor numbers for this period. From the Google analytics output it was possible to identify some user journeys of visitors who accessed more than one QR code landing page: both physical journeys between QR codes and conceptual journeys along story links. In Figure 6 a visitor visits three story sections. The first section is accessed by scanning a QR code. Next, the user follows a biographical Story Link about the artist. This user then travels to another artwork and reads two separate sections about a single artwork: *Ferdia at the Ford*. This is both the children’s text and the adult’s text. In other words, they scanned both codes. This could have been by mistake, or perhaps out of curiosity to see the difference in content.



**Figure 6. A visitor journey through the physical and conceptual space. The time represents an average page dwell for that page (rather than the actual visitors duration)**

In Figure 7 we can see the journey of a visitor who doubles back to read about *Untitled* by Tony Cragg for a second time. Figure 8 shows the visitor journey of a highly engaged user who has walked up IMMA’s West Avenue from the Kilmainham entrance and then ventured into the Formal Gardens (Figure 9), reading many of the

recommended sections as they go. In one case, the user drills down through all 4 of the available story links from that point.

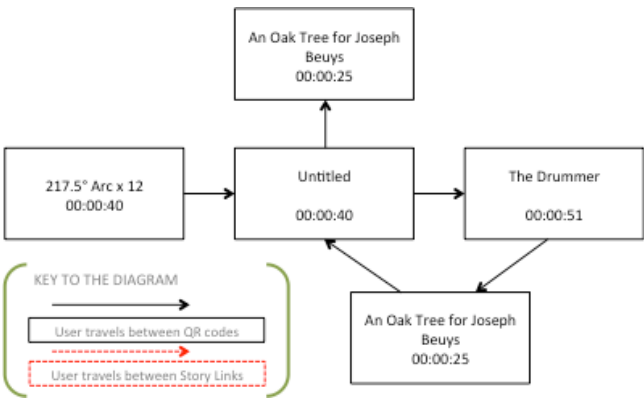


Figure 7. The visitor journey of User 16

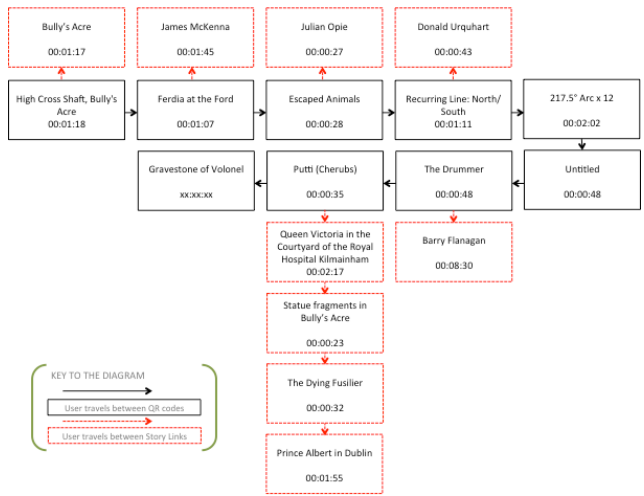


Figure 8. The visitor journey of User 21

Given the relatively small number of users who visited more than one section it is difficult to draw firm conclusions about whether physical or **conceptual** links were generally preferred, since visitors were often scanning different codes to one another, which could affect the story links that were available. However, **analysis reveals** that visitors who accessed a story link once were quite likely to do so again, whereas those who ignored them from the start continued to do so. Figure 10 shows three user journeys. An asterisk indicates that a section was accessed through a story link (those without were the QR code landing pages).

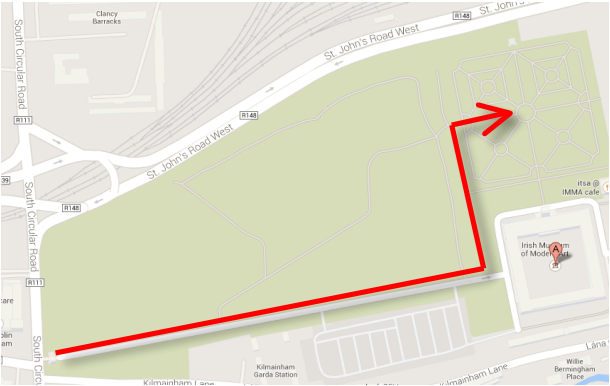


Figure 9. The journey through IMMA of User 21.

As mentioned previously, many visitors engaged with the QR codes without speaking directly to an experimenter and the survey was optional. Still, a few fairly informal and brief responses were collected through the survey. One respondent noted that they had difficulty downloading a QR scanner. Another liked the technology but felt that the style of information was not engaging. However, generally the feedback was positive. Comments included:

“would like to have had more time to explore art trail”

“adds more to the experience”

“excellent tool”

“it is a nice new way to learn more about artworks in the grounds”

“Loved it!!”

None of the users mentioned that they found the information repetitive or were put off by finding the same information in more than one place. One particular respondent did note that “Maybe I’m not a typical user in that I feel I would want to visit all the QR codes and read about all the pieces available rather than just dipping in and out or cherry picking things”. However, there is no reason why the technology could not be used in this way and in fact interested visitors can choose to pick up a leaflet and follow a specified trail. Or, indeed, the microsite could easily be authored to lead visitors from one artwork to the next, by providing more specific navigation in the space reserved for pointing out the physical neighbourhood.

All of the engagement with the technology was fairly ‘impromptu’ and none of the visitors were specifically recruited or led into using the technology, other than possibly having seen the QR code trail advertised on social media. With this in mind, overall, the evaluation seemed to show that visitors were curious to scan and engage with the QR code technology. Many were likely to follow the conceptual links when they were provided and the responses given indicate a positive attitude towards the technology and content.

217.5° Arc x 12 3760 00:00:40	High Cross Shaft, Bully's Acre 3752 0:00:36	217.5° Arc x 12 3760 00:02:02
Untitled 3788 00:00:40	*Bully's Acre 3751 00:01:17	*Bernar Venet 5134 00:11:55
The Drummer 3716 00:00:51	Ferdia at the Ford 3759 00:01:07	SENTINEL VIII 3764 00:01:11
An Oak Tree for Joseph Beuys 3769 00:00:25	*James McKenna 3787 00:01:45	Back of Snowman 3757 00:00:40
Untitled 3788 00:01:32	Escaped Animals 3774 00:00:28	Burgoyne's Bell from the Royal Hospital Bell Tower 3753 00:00:36
SENTINEL VIII 3764 xxxxxx	*Julian Opie 3789 00:00:27	Byzantine 3749 00:00:52
	Recurring Line: North/South 3844 00:01:11	Slattery's Lamp 3747 00:00:50
	*Donald Urquhart 5129 00:00:43	Signage for a 35 Floor Social Centre 3733 00:01:33
	217.5° Arc x 12 3760	Putti (Cherubs) 3741 00:00:28
	Untitled 3788 00:00:56	*Queen Victoria in the Courtyard of the Royal Hospital Kilmalcolm 3778 00:00:42
		*Putti from the Queen's Statue 5144 00:01:00
		Patrick Ireland 1972 - 2008 3742 00:01:58

**Figure 10. Three user journeys. The left-hand user has not opened any story links.**

## FUTURE WORK

Storyscope provides visualisations of story events on maps and timelines which can now be linked from a microsite. Future work will involve investigating whether this type of visualization can help visitors to understand the relationship between artworks better than carefully authored story text. For example, by making it easier to immediately see why artworks on the trail are considered conceptually close, e.g. if they have different artists but the artists studied in the same place and/or at the same time. In the study presented, this type of information was only available by reading the stories. Future work will also investigate whether the same approach can support visitors who are following trails, rather than those who are exploring the place freely. Possibly the preference to see the information related to the physical and conceptual neighbourhood would differ depending on how the visitor is accessing the works.

Another extension is to apply the same approach in a larger physical environment and to larger objects, specifically whether it is possible to scale up the approach to describe how tourist places are related in a big city where tourists decide their own itinerary and may not have time to visit everywhere, but might still benefit from discovering what else is in the city that is conceptually related to the place they are currently visiting. Another approach to explore would be that of visitor contributed content and the extent to which visitor preferences for stopping and engaging with certain artworks or tourist sites can be used to inform future visitors about what they might stop and engage with themselves, using notions of stigmergy to mediate the interaction between visitors. This would also offer the possibility to assess different interaction modes, such as GPS or iBeacons.

## CONCLUSIONS

This paper explores how to support visitors in telling coherent stories across a group of artworks, which they are exploring freely and where they may not visit every artwork that they read about. The scenario evaluated is visitors exploring artworks in the grounds of a museum. The Storyscope environment for supporting museum authoring

is applied to the task of creating a microsite for museum visitors. This site has a number of pages that are accessed by scanning a QR code next to a museum object. The landing page contains some information about the immediate physical and conceptual neighbourhood of the artwork, then below this there are story links that the visitor can click to discover the extended conceptual neighbourhood, which might include other artworks in the grounds. Additional text prompts the visitor to further explore the extended physical neighbourhood from the point where they are standing. The QR code trail was evaluated with visitors to the grounds of IMMA. Google analytics was applied to find out what visitors were doing. A number of visitors were found to show an interest in exploring both the physical and conceptual neighbourhoods of objects. Survey feedback indicated that users enjoyed engaging with artworks in this way. Further work could investigate better ways to visualize to visitors the conceptual relationships between objects, or explore how to scale up the approach for larger physical areas.

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